Ultrasonic Bat Deterrent Technology

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Characteristics of GE Ultrasonic Device

Key Criteria

- Overcome limitations of previous devices
- Broadband ultrasonic emission
- Wide directivity field
- Compact; easily mountable on turbine system
- Less expensive than curtailment solutions
- Robust and easy maintenance
- Compatible with non-GE turbines

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High speed air jet device provides wide frequency range, broad coverage, and reliability

- 10x more airspace volume covered for each deterrent device compared to typical transducer based systems
- No electronics exposed to environment
- Simple hardware mechanisms with easy operations and maintenance
- Proper deterrent operation easily verified with standard instrumentation
- No increase to far-field audible noise

Prior Field Testing Experience

Forward nacelle mounted emitters

Rear nacelle mounted emitters

Tower mounted emitters

Year	Nacelle Emitters	Tower Emitters	Effectiveness
2013	4	0	24.9% (1.75-42.1: 90% CI)
2014	2	2	29.3% (14.7-43.8: 90% CI)
2015	0	4	TBD

DOE Project Goals

1) Develop causal bat behavioral characteristics to understand:
   - How bats respond to various ultrasonic stimuli
   - Deterrent effectiveness on different species and in different bat environments (i.e. foraging, near turbines)
   - How bats interact with operating wind turbines with and without the deterrent operating using video imaging and 3D flight mapping

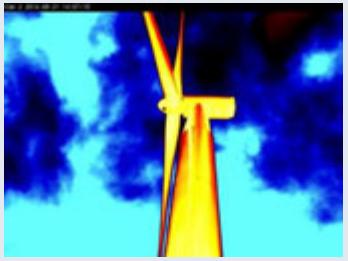
2) Redesign the GE deterrent system based on new behavioral and technology learnings and test the efficacy in a operating wind farm

Designed by Industry Leading Turbine Manufacturer
Tested at Major US Wind Farm
Evaluated by World Class Biologists and Statistician

Flight Room Behavioral Testing to Document Response to Ultrasonic Signals

Ground Based Testing for Demonstration of Redesigned Deterrent

3D Flight Mapping of Bat Motion Around Turbine



Field Testing of Redesigned Deterrent Installed in Operating Wind Farm